

Evaluation Of Web-Based Application E-DMFT Using Usability Testing PSSUQ As Digital Dental Self-Assessment

Dwi Harjanti Silo Putri*, Moh. Husnun Niam**

* Faculty of Dentistry UNISSULA

** Faculty of Dentistry, Department Dental Public Health, UNISSULA

Correspondence: niamfkg@unissula.ac.id

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ABSTRACT

Background: The Decayed, Missing, and Filled Teeth (DMF-T index) is a standard measure for evaluating dental caries experience in permanent dentition. In response to the increasing prevalence of dental caries, web-based application, E-DMFT, was developed to digitize conventional DMF-T assessment into a digital dental self-assessment tool for patients. The present study aims to evaluate the usability of the E-DMFT web-based application using the Post-Study System Usability Questionnaire (PSSUQ).

Method: This study uses a descriptive observational method with a non-experimental (case study) approach. The sample was conducted involving 100 participants from Semarang City who interacted with the E-DMFT application and subsequently completed the Post-Study System Usability Questionnaire (PSSUQ). Usability was evaluated across four scale assessment: system usefulness, information quality, interface quality, and overall user satisfaction. Descriptive statistical analysis was performed by calculating mean scores for each dimension, which were interpreted based on established PSSUQ normative values, where lower scores indicate higher usability.

Result: The result showed mean scores of 2.58 for system usefulness, 2.80, for information quality, 2.49 for interface quality, and an overall score of 2.64. The findings demonstrated that the E-DMFT application achieved favorable usability outcomes across all dimensions, with mean scores predominantly falling within the lower-limit to mean categories that indicated good level.

Conclusion: The E-DMFT web-based application exhibits good usability and strong user acceptance. The E-DMFT has substantial potential as an effective digital platform to support dental self-assessment and early identification of caries experience, contributing to improved access to oral health information and strengthening preventive oral health strategies at the community level.

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INTRODUCTION

The field of dentistry is undergoing a transformation towards an era of technological convergence, one of which is marked by the development of dental self-assessment applications, a digital technology-based instrument that allows individuals to independently assess their dental and oral health status. According to WHO recommendations, the implementation of dental self-assessment is recognized as a global information system in epidemiological surveillance to monitor, evaluate, and control the dynamics of orodental health.¹ In the modern paradigm, dental practice is no longer clinician-centered but has transitioned to patient-centered through self-assessment.² The implementation of self-assessment serves as a monitoring tool that enables early detection and continuous evaluation through conventional and digital approaches. The urgency of implementing self-assessment must be integrated with oral health education to reduce the prevalence of oral diseases now and in the future.

The oral and dental health status in Indonesia remains a major public health concern, primarily due to disparities in the distribution of dentists and the limited availability of oral healthcare human resources.³ These structural limitations contribute to restricted access to dental services, which in turn adversely affects overall population health outcomes.⁴ Moreover, socioeconomic constraints, geographical barriers, and time-related limitations further hinder the utilization of oral healthcare services, exacerbating existing inequalities in oral health access and outcomes.⁵ Data from the 2018 National Basic Health Research (RISKESDAS) indicated that approximately 57.6% of the Indonesian population experienced oral and dental health problems, with a mean Decay–Missing–Filled Teeth (DMF-T) index of 7.1.⁶ The same survey reported a national caries

prevalence of 88.8%, which is classified by the World Health Organization (WHO) as a high caries prevalence. The DMF-T index is widely recognized as the gold-standard epidemiological indicator for assessing caries experience and orodental treatment needs.⁶ Furthermore, the DMF-T index serves as a critical parameter for evaluating caries severity, monitoring the effectiveness of preventive dentistry programs, and informing evidence-based oral health policy development.⁷

Conventionally, DMF-T index assessment is conducted manually using printed forms, which may result in calculation errors and time inefficiency. In the era of technological convergence, integrating digital information systems into dental practice has become imperative to support precise, efficient, and evidence-based care.⁸ Digital solutions offer substantial benefits for dentists, patients, and dental students, including improved time efficiency, reduced costs, and minimized human error. Previous studies have demonstrated the feasibility of digital approaches in dental epidemiology, including the development of a Mobile Application Rating Scale (MARS)-based application for assessing DMFT, OHI-S, and PHP-M indices by the research Nagarajappa & Vyas (2021), as well as study by Mariana et al. (2024) a digital dental calculator providing multiple assessment modules such as DMFT, OHI-S, PHP-M, and the Gingival Index (GI) for dental professionals and students.^{8,9}

To date, no study has developed a DMF-T index application specifically designed for direct patient self-assessment. Given the widespread use of the DMF-T index in oral epidemiology, rapid digital transformation, unequal distribution of dental professionals in Indonesia, and the persistently high prevalence of orodental health problems, this study proposes a web-based self-assessment application focused on DMF-T measurement. The application,

E-DMFT (Electronic Decay–Missing–Filled Teeth), represents the first digital prototype in Indonesia developed for patient-oriented DMF-T self-assessment and is integrated into the “CarioAssess” platform alongside other assessment tools, including CRA and e-deft. E-DMFT is intended to facilitate patient-led evaluation of caries experience and to support preliminary identification of dental treatment needs prior to clinical visits. To enhance adoption and user engagement, the application emphasizes educational and participatory features, positioning E-DMFT as a practical, informative, and accessible digital self-assessment tool for the general population.

Following the development of the E-DMFT application as a fully functional web-based system, the subsequent phase involved evaluating user satisfaction and system performance. Any digital application must undergo a feasibility assessment to determine whether its functionality aligns with end-user needs. One widely used approach for evaluating digital system quality is usability assessment.¹⁰ Among various usability evaluation methods, the Post-Study System Usability Questionnaire (PSSUQ) is a standardized questionnaire designed to measure user satisfaction with digital system performance.¹¹ PSSUQ was selected in this study because it evaluates user perceptions across four fundamental dimensions: system usefulness, information quality, interface quality, and overall system satisfaction.¹²

RESEARCH METHOD

This study adopted a non-experimental descriptive design with a case study approach to assess the usability of the E-DMFT web-based application as a patient-centered digital self-assessment tool. The target population comprised

residents of Semarang City, Indonesia. Based on official data from the Semarang City Statistics Bureau, the population size in 2024 was 1,708,830 individuals. A sample of 100 participants was determined using the Slovin sampling formula.

Participants were recruited based on predefined eligibility criteria. Inclusion criteria consisted of residents aged 12 years or older with fully erupted permanent dentition, access to a smartphone with internet connectivity, and willingness to participate. Exclusion criteria included individuals with cognitive impairments or physical disabilities that could limit interaction with the digital system or completion of the usability assessment.

The study utilized multiple instruments, including internet-enabled mobile devices, the “CarioAssess” web-based platform incorporating the E-DMFT module, and the Post-Study System Usability Questionnaire (PSSUQ) administered electronically via Google Forms. The PSSUQ comprises 16 items rated on a seven-point Likert scale and evaluates usability across four domains: system usefulness, information quality, interface quality, and overall system satisfaction.

The research protocol received ethical approval from the Health Research Ethics Committee of the Faculty of Dentistry, Sultan Agung Islamic University. Prior to participation, all respondents were provided with detailed information regarding the study objectives, procedures, and potential benefits, and written informed consent was obtained. Participants independently accessed and interacted with the E-DMFT application using their personal mobile devices, followed by completion of the PSSUQ questionnaire.

Data were collected and processed using Microsoft Excel. Descriptive statistical analysis was conducted by calculating mean scores for each

PSSUQ domain. Usability outcomes were interpreted in accordance with established PSSUQ scoring principles and normative benchmarks to determine the overall usability performance of the E-DMFT application.

RESULTS

A total of 100 respondents residing in Semarang City participated in this study. Demographically, the age distribution was

predominantly represented by participants aged 16–17 years, comprising the largest proportion of the sample. Participants aged 20–25 years accounted for a smaller proportion, while individuals older than 25 years constituted only a minor segment of the study population. The geographic distribution of respondents spanned several districts, including Genuk, Pedurungan, and Tembalang, reflecting the local representativeness of the sample in relation to the study setting.

Table 1. Respondent Characteristic Data

Characteristic	Category	Number of Responden (n)	Percentage (%)
Age	15 – 19 years	72	72%
	20 – 25 years	20	20%
	> 25 years	8	8%
Domicile	Genuk District	28	28%
	Pedurungan District	25	25%
	Tembalang District	20	20%
	Other distric in Semarang City	27	27%

The usability testing result of the E-DMFT application was carried out using the Post-Study System Usability Questionnaire (PSSUQ), which is described as follows:

Table 2. Result of the System Use (SysUse) Scale

Scale	Questions						Mean Total
	Q1	Q2	Q3	Q4	Q5	Q6	
SysUse Mean Score	2,58	2,58	2,58	2,58	2,58	2,58	2,58

The System Use (SysUse) scale, comprising items 1–6, assesses effective, efficient, and intuitive system use. Analysis of responses from 100 participants resulted in a mean score of 2.58, which falls within the lower-limit category.

Table 3. Result of the Information Quality (InfoQual) Scale

Scale	Questions						Mean Total
	Q7	Q8	Q9	Q10	Q11	Q12	
InfoQual Mean Score	2,78	2,63	2,83	2,91	2,93	2,69	2,80

The Information Quality (InfoQual) subscale includes items 7–12 and focuses on the quality of system-generated information. The analysis of data from 100 respondents produced a mean score of 2.80, classified within the lower-limit category.

Table 4. Result of the Interface Quality (InterQual) Scale

Scale	Questions				Mean Total
	Q13	Q14	Q15	Q16	
InterQual Mean Score	2,52	2,55	2,59	2,3	2,49

The Interface Quality (InterQual) subscale comprises items 13–15. The analysis revealed a mean score of 2.49, which is positioned within the normative mean category of the PSSUQ scale.

Table 5. Result of the Overall Scale

Overall Scale	
Questions	Overall Mean Score
Q1	2,58
Q2	2,58
Q3	2,58
Q4	2,58
Q5	2,58
Q6	2,58
Q7	2,78
Q8	2,78
Q9	2,78
Q10	2,78
Q11	2,78
Q12	2,78
Q13	2,52
Q14	2,52
Q15	2,52
Q16	2,52
Mean Total	2,64

The Overall Scale represents a comprehensive assessment of overall user satisfaction, calculated as the mean score of all 16 items in the PSSUQ instrument. The analysis yielded an overall mean score of 2.64. This score falls within the lower-limit category, indicating favorable overall performance of the E-DMFT application in terms of usability and user satisfaction.

Table 6. Comparisson of PSSUQ Norms with Research Result

Scale	PSSUQ Norms			Score	Category Score
	Lower limit	Mean	Upper Limit		
SysUse	2,57	2,80	3,02	2,58	Lower limit
InfoQual	2,79	3,02	3,24	2,80	Lower limit
InterQual	2,28	2,49	2,71	2,49	Mean
Overall	2,62	2,82	3,02	2,64	Lower Limit

Based on the comparison of scores with the PSSUQ normative values shown in Table 6, the System Use, Information Quality, and Overall scales are classified within the lower-limit category, whereas the Interface Quality scale falls within the mean category.

DISCUSSION

This study fundamentally aimed to address the research question of how a web-based digital platform functions as a self-assessment tool for determining dental treatment needs, as perceived by users within the target population. The quantification of these subjective perceptions was achieved through the implementation of the validated usability instrument, the Post-Study

System Usability Questionnaire (PSSUQ), which is designed to evaluate digital system quality in relation to user needs.¹⁰ The PSSUQ framework disaggregates user experience into key analytical domains, namely system functionality and effectiveness (System Use), clarity and quality of information (Information Quality), interface comfort

and aesthetics (Interface Quality), and overall system performance (Overall).

A comprehensive analysis of the quantitative metrics—yielding mean scores of 2.58 for SysUse, 2.80 for InfoQual, 2.49 for InterQual, and 2.64 for the Overall scale—when compared with established PSSUQ normative values and relevant usability literature, provides an integrated assessment of the current performance of the E-DMFT application. The findings demonstrate satisfactory functional capability and strong informational quality, indicating that the application effectively supports users in understanding and interpreting clinical self-assessment content. However, the comparatively lower performance observed in the Interface Quality domain highlights interface-related limitations that persist at the current stage of development, particularly in achieving an optimal balance between visual design and system performance.⁸

The mean System Use score of 2.58 places the E-DMFT application within the lower-limit range of the good usability category, indicating that its core functional features can be effectively and efficiently operated by the target users. Key workflow processes—including user registration and authentication, DMF-T index data entry, intraoral photograph submission, and questionnaire completion—were successfully performed by most participants, reflecting adequate functional performance in accordance with the ISO definition of usability, which emphasizes effectiveness, efficiency, and user satisfaction within a defined context of use.^{13,14} Moreover, the automation of DMF-T index calculations represents a paradigmatic transition from error-prone analog procedures to a more structured and efficient digital system, enhancing data accuracy and integrity and aligning with previous findings on the benefits of

digital health applications in reducing transcription and calculation errors.¹⁵

The Information Quality scale demonstrated strong performance, with a mean score of 2.80 placing it within the lower-limit quartile of the PSSUQ normative range. This favorable outcome highlights the strength of the E-DMFT application in delivering dental health information related to caries experience and treatment needs in a manner that is both relevant and easily comprehensible. The prominence of the InfoQual dimension directly supports the primary objective of the application as an educational and patient-empowerment tool. These findings are consistent with those reported by Darwita et al. (2023), who confirmed the effectiveness of web-based educational interventions in improving caries risk literacy.¹⁶ By extending this concept to the general population, the E-DMFT application contributes to increasing users' awareness of their oral health status, a critical factor given the well-documented bidirectional relationship between low oral health literacy and high caries incidence.¹⁷ Moreover, the provision of quantitative, individualized caries experience data through the application has the potential to enhance user motivation toward positive oral health behavior change.

The Interface Quality (InterQual) dimension yielded a mean score of 2.49, positioning it within the normative mean category of the PSSUQ scale. Although this score technically remains within the lower-limit range of the 'good' usability category, its proximity to the upper-limit range suggests that interface quality represents the most prominent area for improvement. Given the PSSUQ scoring principle, in which higher scores indicate poorer system performance, this finding implies that despite the E-DMFT application's strengths in functionality and information delivery, aspects related to visual presentation and interaction

comfort have not yet reached optimal levels. User perceptions indicate that the interface design may lack visual appeal or that the arrangement of interface elements could be further refined to enhance clarity and navigational efficiency.¹³

As emphasized by Fiorenza and Tolle (2023), interface quality plays a critical role in shaping user engagement and sustained use of digital health applications.¹⁸ Interfaces that are confusing or lack aesthetic appeal may reduce users' willingness to engage in repeated use. In the context of the E-DMFT application, which is designed as a tool for monitoring dental caries, limitations in interface quality may constitute a barrier comparable to the physical or financial access constraints encountered in conventional healthcare services.⁵ Therefore, interface design enhancement should be prioritized in subsequent stages of application development.

The overall mean score of 2.64, which also falls within the lower-limit range of the 'good' usability category, reflects favorable overall system usability as perceived by users and comprehensively addresses the research question. The E-DMFT application is demonstrated to be a functionally valid self-assessment instrument with strong informational performance, although minor limitations remain in interface quality. Its primary strength lies in the quality of information provided, which has the potential to enhance oral health literacy and increase awareness of oral hygiene as an important determinant of systemic health.¹⁹ Moreover, the E-DMFT application shows considerable potential as a digital tool to support dental health services, particularly in settings characterized by disparities in the distribution of dental professionals and limited access to healthcare services.^{3,4} With targeted improvements in interface design, the E-DMFT application could evolve into an effective digital triage instrument,

facilitating early detection and contributing to improvements in overall orodental health outcomes.

CONCLUSION

In conclusion, the evaluation of the web-based E-DMFT application using the Post-Study System Usability Questionnaire (PSSUQ) indicates that the application demonstrates good overall usability. The System Use dimension confirms that the application is generally easy to operate, while the Information Quality dimension highlights the clarity and relevance of the information provided. Nevertheless, improvements are required in the Interface Quality dimension, particularly in visual design, layout, and navigation efficiency. Overall, the E-DMFT application is a beneficial digital self-assessment tool for assessing oral health status and supporting dental care planning, with further interface optimization needed to enhance user experience.

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